WILLATS'S

SCIENTIFIC MANUALS, No. I.

PLAIN DIRECTIONS

FOR OBTAINING

PHOTOGRAPHIC PICTURES

BY

THE CALOTYPE, ENERGIATYPE,

AND OTHER PROCESSES ON PAPER;

INCLUDING THE

CHRYSOTYPE, CYANOTYPE, CHROMOTYPE,

ETC., ETC.

WITH ALL THE LATEST IMPROVEMENTS.

THIRD EDITION WITH ADDITIONS.

EDITED

BY JOHN H. CROUCHER.

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Price One Shilling.

ANOTHER edition of one thousand copies of this little work having been exhausted, the publishers avail themselves of the opportunity afforded them of introducing such improvements as have been made public during the last twelve months. In common with the Editor, they beg to acknowledge the favour with which their efforts to elucidate the interesting science of Photography have been so generally received.

LONDON, *August*, 1847.

PLAIN DIRECTIONS

FOR

OBTAINING PHOTOGRAPHIC PICTURES BY THE CALOTYPE, ENERGIATYPE, AND OTHER PROCESSES ON PAPER.

THE art of Photography, by which, through the agency of light, the most accurate and beautiful representations of objects are obtained, is the fruit of modern science and research. The darkening of nitrate of silver under the rays of the sun had, indeed, been long known, but no attempt was made to apply this fact to the purposes of art until 1802, when Mr. T. Wedgwood published a "Method of Copying Paintings upon Glass, and making Profiles by the Agency of Light upon Nitrate of Silver." That eminent chemist, Sir Humphrey Davy, assisted Mr. Wedgewood in his inquiries; but being unable to discover any mode of fixing the images obtained, the experiments were abandoned. About 1814, Mr. Niepce, of Chalons sur Marne, turned his attention to this subject; and in 1827, presented to the Royal Society of London some specimens of pictures produced by the agency of light on glass, copper plated with silver, and highly planished tin; soon after which he entered into partnership with M. Daguerre. The latter gentleman, after repeated but it would seem fruitless attempts to prepare a sensitive paper, entered upon those experiments which ended in the discovery of the beautiful

process on silver plates which bears his name. In the interval, Mr. Henry Fox Talbot made known the results of his inquiries into the action of light upon salts of silver, in a paper read before the Royal Society in January, 1839, which he followed up in the succeeding month by another, detailing his method of preparing a paper for photographic purposes, and fixing the designs. This paper was not, however, sufficiently sensitive to be used in the camera-obscura; but Mr. Talbot continuing his experiments, found means to increase the sensibility of his paper, and in 1841 patented the process, to which he has given the name of CALOTYPE, but which has recently (in accordance with the fashionable photographic nomenclature) been termed the TALBOTTYPE. Many distinguished scientific men have lately devoted their attention to this subject; and various processes on paper have been from time to time announced by—Sir John Herschel, Mr. Robert Hunt, and others, under the names of AMPHITYPE, ANTHOTYPE, CHROMOTYPE, CHRYSOTYPE, CYANOTYPE, ENERGIATYPE, etc., etc. The Daguerreotype, from its peculiarity and importance, demands a separate consideration, and is made the subject of a distinct number of the present series.* Avoiding, as far as possible, all scientific technicalities, we shall endeavour to give such concise and plain directions as will enable the amateur to obtain the most successful results. Those who may desire to learn something of the philosophical principles involved in the experiments brought under their notice in the subsequent pages, will do well to consult Mr. Robert Hunt's valuable work, entitled "Researches on Light," published in the course of 1844.

Before entering on the various processes we are about to describe we shall briefly notice the apparatus which the amateur will require, in performing this class of photographic operations. Where camera pictures are not desired, it will be simple and inexpensive.

Some camel's-hair brushes, a quire or two of good writing paper, and a few sheets of blotting-paper, are indispensable. The brushes should be large, the hair collected together in one pencil, and they must never be bound in tin. A separate brush is required for each solution, which should be thoroughly washed after using. The paper should be carefully selected: to a want of sufficient caution in this

* Photographic Manuals, No. 2. Second Edition. Practical Hints on the Daguerreotype. T. & R. Willats, 98, Cheapside, London.

respect, must be attributed the constant failures of many experimenters. Whatman's or Turner's superfine yellow or blue wove, is generally recommended; we have lately met with some very excellent paper, which can be had at the publishers. Every sheet should be examined by a strong light, and all those rejected which have any spot upon them, as also those which are found on trial to imbibe the solutions unequally. One side of the sheet should have a pencil mark upon it, by which it may be recognised. The blotting-paper must be the white wove, and the sheets used in different stages of the process should be kept separate. A trough of Berlin ware, which is not acted upon by chemical preparations, and a slab of the same material, are also required for preparing and washing paper.

Copying Frame.

All that is absolutely essential for this purpose, is a piece of plate glass of a sufficient size, and a board of similar dimensions covered with soft flannel; these, with the prepared paper and object to be copied placed between them, may be kept in contact by three or four binding screws. But the more convenient apparatus is represented at fig. 1 consisting of a frame in which a piece of plate glass (*a*) is fixed, in a frame with a wooden back covered with a cushion of flannel. The back may be removed to admit of the introduction of the paper and object, and when replaced, may be pressed evenly and firmly against the glass by screws (*cc*) placed at the back. A sliding-top covering the glass excludes the light, until it is desired to submit the paper to the action of light, or to protect it from change if kept for a short period without setting.

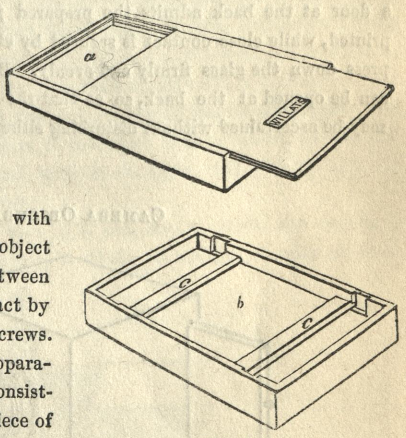


Fig. 1.

The Improved Pressure Frame (Fig. 2.)

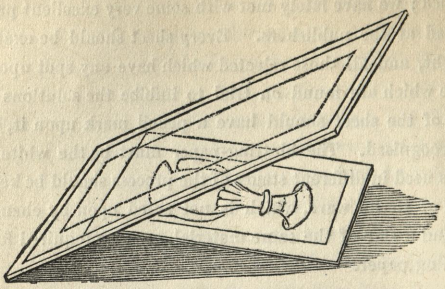


Fig. 2.

This is a more perfect form of apparatus than that just described; a door at the back admits the prepared paper and the object to be printed, while close contact is secured by clamps at each corner, which press down the glass firmly and evenly. By a simple arrangement, it can be opened at the back, so as that the progress of the impression may be ascertained without disturbing either the paper or the copy.

Camera Obscura.

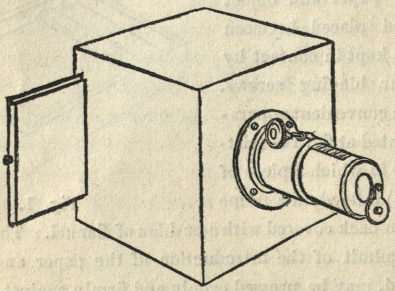


Fig. 3.

The Camera Obscura adapted for photographic purposes, is a very superior instrument to that commonly sold under the name. The lens may be either achromatic or miniscus.

WILLATS'S IMPROVED CAMERA, (FIG. 4,)

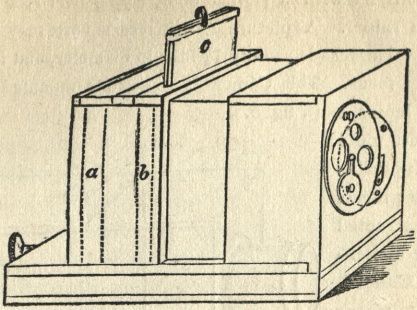


Fig. 4.

Which may be used for any photographic purpose, is a box, in the front of which the lens is bedded, by which an increase of light is obtained, the quantity admitted being regulated by a diaphragm having apertures of different diameter. The back part of the camera slides into the front, and to secure a very accurate adjustment, is mounted with a screw. It is moved in or out by turning a small handle at the back. The frame with the ground glass is furnished with a moveable top and sides, which, when extended, exclude the light, and aid the operator in determining the best focus.

The second frame consists of a box, which, when the camera is applied to processes on paper, is made to receive a piece of slate,

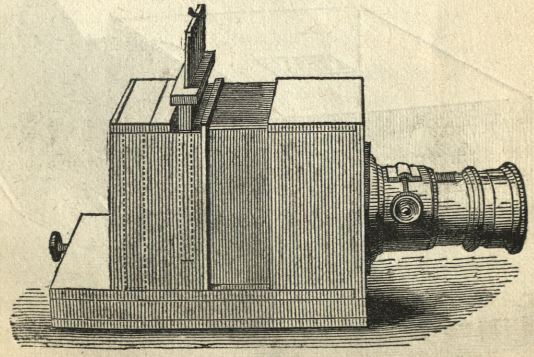


Fig. 5.

iron, or glass, which is held tight by a spring at the back: this frame is furnished with a sliding door, laying over the top of the camera when raised. A picture four-inches square may be taken in this camera. The lens is usually $1\frac{3}{4}$ inch in diameter, and from eight to twelve inches focus. This Camera is sometimes mounted with double combination lenses, as in fig. 5.

A Camera more especially adapted to the Calotype process is now constructed on a plan recommended by Mr. Cundell. A single miniscus lens may be used, or two miniscus lenses, each about three inches in diameter,

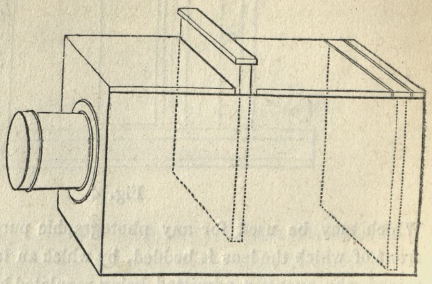
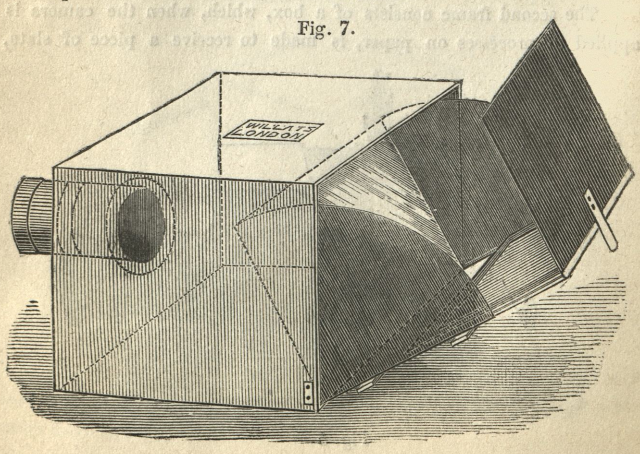


Fig. 6.

and twenty-four inches in focus, are mounted in a sliding tube, their conjugate foci being as that of a single lens of thirteen inches. These, with an aperture of about one three-tenths inch, and with one or more stops behind the lenses, give a picture beautifully defined. The focus is adjusted, and the prepared paper exposed, much on the same principle as the other camera above described.

Fig. 7.



The Camera on the other side has a very novel and convenient arrangement for obtaining the focus, and exposing the prepared paper: it is the invention of Mr. Hazel. The frame destined to receive the slider containing the paper, and the ground glass upon which the focus is obtained, are arranged at right angles to each other and turn upon a joint, at the lower edge of the back part of the Camera. The focus being obtained, the slider with the prepared paper is introduced into the frame, when, by turning it upwards, the ground glass falls to the bottom of the camera, while the slider exactly occupies its place. By an ingenious arrangement, a short lever connected with the slider, at the same moment raises the shutter which secures the paper from the light.

The Camera represented, Fig. 9, is a new and very useful article, being made to fold up into the compass of a moderate sized book, and may be carried in the pocket without inconvenience. It is so arranged as to put together with the utmost ease, and is kept securely in its place by screws in the sides and back.

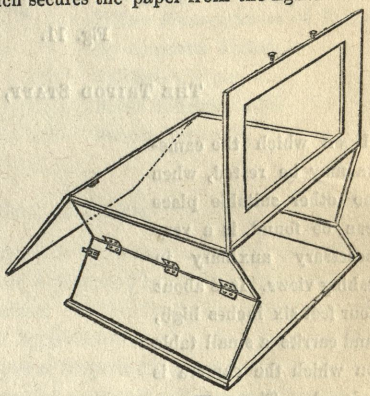


Fig. 9.

THE PHOTOGRAPHIC ETNA, (FIG. 10,)

For bringing out the picture by the aid of steam, is highly useful, as the picture is kept moist while the process of development is going on. This is a very great improvement on the tin bottle formerly used, the rapid drying of the paper causing great discoloration and want of uniformity in the development of the image. The old form with a slate side, may however be procured by those who prefer its use. Fig. 11.

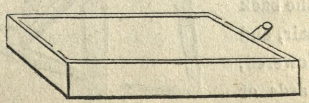


Fig. 11.

Fig. 10.

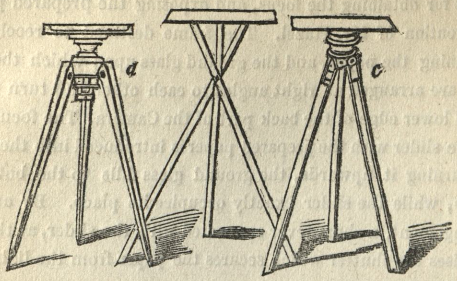
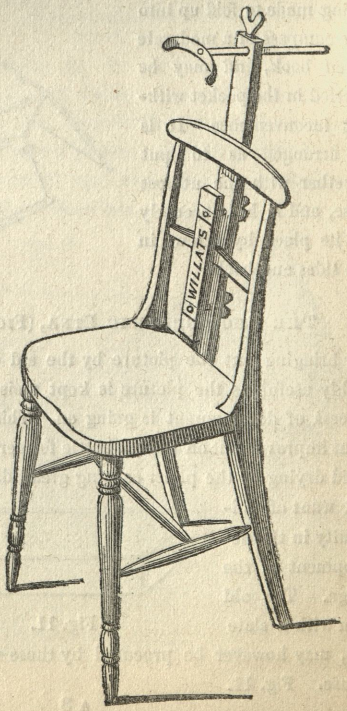


Fig. 11.

THE TRIPOD STAFF, (FIG. 6,)

Upon which the camera may be rested, when no other suitable place can be found, is a very necessary auxiliary in taking views. It is about four feet six inches high, and carries a small table on which the camera is placed. There are several varieties, differing in their construction and price.



THE HEAD REST, (Fig. 12.)

May be fixed to the back of an ordinary chair, and may be raised or lowered, and moved forwards or backwards, at pleasure. It is indispensable in taking portraits.

Chemicals.

These should be all of the best quality, and should only be purchased of respectable parties who will guarantee their purity. Cheap chemicals are seldom economical, as the adulteration of any of them will interfere most annoyingly with the successful prosecution of the experiment. The following list comprises almost every article required in the processes hereafter described :—

Nitrate Silver* in chrystals	Ammonia-citrate Iron
Iodide Potassium	Ferro-sesquicyanuret Potassium
Bromide Potassium	Yellow Ferro-cyanate of Potash
Hyposulphite Soda	By-chromate Potash
Pure Gallic Acid	Sulphate Copper
„ Succinic Acid	Nitric Muriatic Acid
Proto-sulphate Iron	Strong Ammonia

THE CALOTYPE.

The Calotype, or Talbottype, is, as we have already mentioned, the invention of Mr. Fox Talbot, or is claimed by him.† It has been much improved since its first introduction. To Mr. Cundell in particular we are indebted for many practical suggestions, which he first communicated to the world in the' Philosophical Magazine,'‡ and the more recent experience of other photographers has produced valuable modifications of the original process. Giving such simple directions for conducting it as we have found the most likely to produce satisfactory results, we shall include such variations as seem worthy the attention of the amateur.

* The Nitrate of Silver in solution is very easily affected by light, and should be kept in a dark place.

† So early as April, 1839, the Rev. J. B. Reade made a sensitive paper, by using an infusion of galls after nitrate silver. By this process Mr. Reade obtained several drawings of microscopic objects, by means of the solar microscope. The drawings were taken before the paper was dry. In a communication to Mr. Brayley, Mr. Reade proposed the use of gallate or tannate of silver; and Mr. Brayley, in his public lectures in April and May, explained the process, and exhibited the chemical combinations which Mr. Read proposed to use.

‡ No. 169, May, 1844.

Preparation of the Iodized Paper.

Having selected paper of a close and even texture, and fine surface, such as that recommended p. 4, and marked it on one side with pencil, wash this side over carefully with a solution, consisting of 30 grains nitrate silver, dissolved in one ounce distilled water, which apply plentifully with a brush, thoroughly wetting every part, but leaving no moisture unabsorbed; this should be done on a hard smooth board, and thoroughly dried in the dark. Then take a solution of two hundred grains of iodide potassium in half-a-pint of water, to which fifty grains of salt have been added; draw the paper over the surface of the liquid, letting it repose upon it, when plastic, for a few seconds, never more than one minute. After dipping, drain it, and lay it flat until about half dry, then set it afloat in clean water for ten minutes, drawing it now and then along the surface: hang it in the air to dry, and when dry smooth it by pressure. It is of the utmost importance that all the soluble salts should be got out of the paper, and this is readily effected by leaving it floating for a time in water: a rougher washing would loosen the iodide of silver. This paper will keep some time if carefully laid by in a portfolio.

Application of the Gallo-Nitrate of Silver.

Dissolve fifty grains nitrate silver in two ounces of distilled water, to which add one-fifth of its volume of glacial acetic acid. Dissolve also a small quantity crystallized *gallic acid* in distilled water, about eight grains to the ounce.* When about to use, mix one part of the latter solution with two parts of the former, mixing however only a sufficient quantity for immediate use, as the resulting liquid decomposes very rapidly. This, and all the operations connected with the Calotype, should be conducted in a room from which daylight is entirely excluded: it is, indeed, preferable to surround any artificial light, which may be used, with a screen of yellow glass, gauze, or paper, the rays which pass through materials of this colour having little or no influence on the most sensitive preparations. The iodized paper may now be washed evenly over on the prepared side, which may be recognised by its pale yellow colour, with the gallo-nitrate mixture, and must then be immediately

* A small quantity only of the gallic acid solution should be made at once, as it soon undergoes a change, becoming of a strong yellow colour, and unfit for use.

transferred to clean blotting-paper, and all the moisture carefully removed from the surface. A more even distribution of the gallo-nitrate solution may, perhaps, be obtained by pouring a little out on a slab, and passing the iodized paper over it, taking care that contact in every part is secured, and blotting as before. To save time, the gallic acid may be applied previously, and the paper kept thus, half prepared.

Placing in the Camera.

Having prepared iodized paper as directed above, in which state it is called calotype paper, it should be quickly transferred to the camera frame, enclosed between a plate of slate or iron, and a piece of plate glass to keep it smooth. If the slate or iron be gently warmed, the sensibility of the paper will be increased. The camera must now be put in the proper position, directed towards the object to be copied, and a good clear picture obtained on the ground glass. This picture, when an achromatic glass is used, will give a good working focus, but when the camera is fitted with a miniscus, or any other kind of non-achromatic lens, a peculiar adjustment is necessary to obtain what is called the chemical focus, which differs materially from the optical or visible focus. This chemical focus is about one thirty-sixth part shorter than the other, but the scale should be adjusted according to the lens and camera used. The frame, with the prepared paper, the shutter being perfectly closed, is now placed in the camera. The time of exposure here depends upon so many circumstances,—the strength of the light, the colour of the object, the description of lens used in the camera, etc., etc., that it is impossible to give any practical rules upon the subject,—experience will be the best instructor. With a single achromatic lens in the morning sunshine, from thirty to sixty seconds is perhaps requisite for a building, and from one to two minutes for a portrait: in the shade, from two to three minutes are required for either. Pictures are taken in a much shorter time, in from ten to twenty seconds, by using a combination of lenses, or with a single lens, under very favourable circumstances. The best position for taking a building, is a distance about twice the measure of its greatest dimension, and from an elevation of about one-third of its height. Where some parts of the building are nearer than others, place the focus to that part which it is most desirable to have clear, and neglect the others. It is not advisable to take new and old buildings in the same

picture, as the time necessary for the old will over-do the new. The sky is frequently overdone, which may be prevented by interposing a black-screen upon the glass over that part which corresponds to it, and which may be previously ascertained by reference to the ground-glass. Portraits should be taken in the open air, but not in the sun. The best uniform back-ground is a blanket, but figures may be grouped in front of a house, or a mass of foilage. There should not be too much white in the dress, as it will be solarized or blotched, before the other parts are distinctly pourtrayed. More particular directions for obtaining artistical portraits will be found in No. 2 of the present series.

Bringing Out the Impression.

When the paper is removed from the frame, always in the dark, nothing is visible; it must then be again washed over with the gallo-nitrate of silver, and exposed to a radiated heat from a gentle fire, or a bottle of hot water, or to what is still better a jet of steam, holding the paper over it, never suffering the paper to become in any part perfectly dry.* When the picture is, in the opinion of the operator, sufficiently distinct, it must be carefully washed in distilled or rain water, as warm as the finger can bear—the water being changed once or twice, and then dried in blotting-paper.

Fixing Process.

To fix the picture, soak it for two or three minutes, or longer if strongly developed, in a solution of half an ounce of hyposulphite soda to a pint of water, turning it occasionally, and then soak it in water from twelve to twenty-four hours, according to the thickness of the paper, and dry it. The sweetness of the hyposulphite of silver, which is readily communicated to any quantity of water, affords an excellent means of testing when the picture is freed from its influence. It should be washed until the water is perfectly tasteless.

The Calotype process is intended solely for the camera-obscura, and the pictures so obtained are all negative; that is, the lights and shadows are reversed. From these, however, any number of positive pictures, or

* A convenient apparatus for this purpose is described page 9, and may be had of Messrs. T. & R. Willats.

pictures in which the lights are represented by lights, and the shades by shades, may be taken in the manner described under the next head.

Mr. Fox Talbot has published a method of removing the yellowish tint from pictures taken on calotype and other photographic papers prepared by nitrate of silver, by plunging the picture into a bath composed of hyposulphite of soda, dissolved in ten times its weight of water, and heated nearly to the boiling point. The picture should remain in it about ten minutes, and be then washed in warm water and dried. By this means, he says, the picture is rendered more permanent, and the lights whiter. He also recommends the following means for improving photographic pictures :—

"A copy or reversed impression of a photographic picture is taken in the ordinary manner, except that it remains in the light twice the usual time; its shadows are thus rendered too black, and its lights not sufficiently white. It is then washed and plunged into a bath of iodide of potassium (of the strength of five hundred grains to each pint of water) for one or two minutes, which makes the picture brighter, and its lights assume a pale yellow tint. After this it is washed, and immersed in a hot bath of hyposulphite of soda, until the pale yellow tint is removed, and the lights remain quite white. The pictures, thus finished, have a pleasing and peculiar effect of light and shade, which is not easily attainable by other means."

The transparency of calotype and other pictures may be increased by causing melted wax to penetrate the pores of the paper in the following manner. A small quantity of white wax is scraped on the back of the picture; it is then placed between two other papers, and a hot iron passed over it, which melts and spreads the wax. Or a little boiled oil may be spread over it, and the excess removed by bibulous paper. Canada balsam, or mastic varnish, with turpentine, are very good materials for the same purpose.

It may be necessary to remind the reader, that the CALOTYPE is a patented process. In the two patents obtained by Mr. Fox Talbot, the use of the following processes is claimed as his exclusive right.

The employment of gallic acid, or tincture of galls, in conjunction with solutions of silver, to render prepared paper more perfect. The obtaining portraits from life by photographic means upon paper. The employing Bromides for fixing the image obtained. The transferring pictures from one sort of sensitive paper to another. The employment of

boiling sulutions of hyposulphites, to give increased whiteness to calotype and other photographic pictures; and the process of waxing, when the picture has been rendered more transparent by these means. The process of warming the paper, during the formation of the image, by placing a warm plate of iron behind it to increase the sensibility. The employment of iodized paper excited or rendered sensitive by a liquid, containing only a small portion of nitrate of silver, and subsequently dried; so as to preserve its sensitive state. The varying lights and shadows of a picture by iodide of potassium, and the fixing the picture so changed. The placing a sheet of white or coloured paper behind photographic pictures after having waxed them. The obtaining enlarged portraits and pictures by throwing a magnified image thereof, by lenses, on photographic paper. The application of photography to printing, by arranging suitable letters or figures, so as to form pages, and making photographic images thereof. The system or combination of the following several photographic processes into one, whereby permanent and perfect copies of the positive kind are obtained, namely, the formation of the negative copy—the fixing it, so that it shall have the requisite transparency, and endure great subsequent exposure to the light—the formation of the positive from the negative copy, and its permanent fixation.

The subjoined modification of the Calotype process has been kindly furnished by a very successful practitioner:—

1. Wash the paper with a brush filled with a solution of nitrate silver three grains, distilled water one ounce.

2. When it is half dry, draw it over the following solution, letting it float on the surface for about half a minute:—Iodide of potassium 200 grains, salt 500 grains, water half-a-pint; then withdraw it and set it afloat in pure water for ten minutes; dry and preserve in a portfolio.

3. When you wish to use the paper, prepare three solutions: No. 1, Nitrate silver 50 grs.; acetic acid two drams; water one dram. No. 2, A saturated solution of gallic acid. No. 3, 15 drops of No. 1; 15 drops of No. 2; water 90 drops. Cover the face of the paper with this solution, by means of a very soft brush; taking up the excess of liquid with blotting-paper; put it into the camera, and expose it for a time, depending on the strength of the light.

4. After taking it from the camera, brush it quickly over with a

mixture containing 30 drops of solution No. 1, 30 drops of solution No. 2, 60 drops water; then expose to heat until the picture is sufficiently developed.

5. Well wash the picture and pass between blotting-paper, then into a bath of hyposulphite. Wash it afresh in plenty of water and dry.

Mr. Brodie, whose specimens of Photography upon paper are so beautiful, has kindly communicated the following modification of the Calotype process which he has adopted.

A good paper (Mr. B. prefers Nash's) is marked, the marked side passed over a solution of ten to fifteen grains nitrate silver in one ounce distilled water, every part touching the solution, and is dried gently by the fire. It is then immersed in a bath of iodide potassium fifteen grains to the ounce of water, dried, and afterwards soaked in plenty of water for twelve or fifteen hours. Before placing in the camera, it is washed over with a solution containing nitrate of silver and acetic acid in the proportion of about one-tenth of that used in Mr. Talbot's formula, gallic acid being omitted. When removed from the camera, the picture is brought out by dilute gallic acid without heat. When sufficiently developed immerse in water ten or fifteen minutes, then apply the hyposulphite soda, of the strength of one ounce in a pint and a half water, and wash carefully, as before directed.

Papers that have undergone repeated washings are liable to become rough and to have the pile raised. Mr. Brodie recommends that such proofs should be placed between two or three sheets of highly glazed paper, and rubbed well over with a smooth ivory paper knife, by which means the paper will again acquire a fine surface. The same gentleman has suggested a very elegant method of producing the appearance of sky on a positive picture, which is often wanting from that part of the negative having become entirely and equally darkened. By laying a piece of black paper over the picture when taken from the printing frame, and gradually moving it downwards from the top, a nice gradation of tone is produced, which gives a fine effect to the picture.

Process of M. Blanquart Evrard.

M. Blanquart thinks that the inconstant and defective results of the photographic processes on paper, may be traced to an incomplete

and too superficial preparation. His plan of procedure is somewhat like that of Mr. Brodie, and may be briefly stated as follows:— 1st. Take paper suitable for negatives, and having marked it, lay it on the surface of a solution of 30 grains nitrate silver in 900 grains distilled water, taking care that it touches in every part. Let it remain floating for one minute, then take it out, letting it drain from one of the corners, and lay it flat on an impermeable surface, such as a piece of oil-cloth, and let it dry slowly, taking care not to let the fluid settle in places which will produce stains. 2nd. Plunge the paper, the silvered side downwards, in a bath of 25 grains iodide potassium, and 1 grain bromide of potassium, in 560 grains water, for a minute and a half, or two minutes if the weather be cold. Withdraw it, taking it up by the two corners, and pass it, with as little disturbance as possible, into a trough filled with distilled water, to wash away any salts which may have been deposited in the paper; when well washed, hang it up to dry. This paper will last some months; the remainder of the liquids may be put into bottles covered with black paper, and preserved for future use. 3rd. When about to take a picture, spread upon a piece of very flat glass, kept horizontal by a support with screws, a few drops of the following solution, viz., 60 grains nitrate of silver, 110 grains acetic acid, 640 grains distilled water. Dissolve the nitrate silver in half the water and add the acetic acid; leave the mixture one hour, and then add the remainder of the water. This preparation must be kept in a well stoppered bottle, and should it become thick, must be carefully filtered before using. Lay the paper on the glass, the prepared side downwards, and pass the hand over it, so that, having thoroughly imbibed the solution, it will perfectly adhere to the glass without leaving creases or air-bubbles. This done, cover it with one or two sheets of thick clean paper damped with distilled water; cover this with a second glass of the same dimensions as the first, and press them close together. Now place them in the camera frame and expose to the light. The time of exposure depends upon the degree of light, and also upon the temperature; experience will best guide the operator. 4th. The paper being removed from the camera, is placed upon a glass or porcelain slab, slightly moistened that it may adhere easily. Pour on it a saturated solution of gallic acid, and the image will immediately appear. Let the gallic acid act until all the half-tints are fully developed, stopping it before the whites begin to change. 5th. Wash the picture by pouring

water over it, to get rid of the gallic acid. 6th. Then putting it again on the horizontal glass, pour upon it a solution 60 grains bromide potassium to 2400 grains water, letting it remain about one quarter of an hour, keeping it always covered. 7th. Wash it in plenty of water, and dry with blotting paper. Other proportions than those above may be used, if the general principles involved in the process as there stated be adhered to. If the paper is placed between two glasses, as here recommended, care must be taken that the ground glass of the camera is so adjusted as to receive the image at precisely the same spot as that in which the paper will afterwards be placed.

M. Blanquart makes and uses his positive paper after the following receipt. He recommends a thick paper highly glazed. Pour into a trough a mixture consisting of 180 grains saturated solution of common salt and 600 grains distilled water; mark the paper and let it float for two or three minutes on the surface of the fluid, taking care that it touches everywhere. Dry it thoroughly with blotting paper; then lay it upon another bath containing 60 grains nitrate silver in 300 grains distilled water. Let it remain while a second sheet is floated and dried; let the fluid run off at one of the corners, and lay it to dry upon a piece of oil cloth, or some other impermeable material. When dry, lay it singly in a box; it will keep for ten or fifteen days. The exposure will generally last about twenty minutes in the sunshine, but should be carried to the highest point so that the high lights are not injured. Take it out and lay it in soft water for a quarter of an hour, then in a hyposulphite bath, 100 grains to 800 water. It can now be looked at in the open light, and the change observed; if properly done, it will at last obtain a blackish tint. To get rid of the hyposulphite, wash it well, and leave it in a large vessel of water for five or six hours at least, drying it with blotting paper. Several proofs may be put into the hyposulphite bath at the same time, and if the picture is well developed and washed, it may remain there at least two hours without injury.*

The following observations on the Calotype process have been kindly furnished to us by Mr. Hazel.

Good calotype paper may be prepared by either of the foregoing processes, but the novice often complains of the tediousness of the

* Condensed from M. Lerebour's pamphlet entitled "Les Papiers Photographiques."

former, and of uncertainty in effect. The following hints and modifications may not be undeserving of notice.

Provide a piece of deal board, of the width of the paper to be prepared, and six or eight feet in length. Pin the paper to this board with bone pins to its entire length, letting the edge of each piece underlap the foregoing one about one-eighth of an inch. Place the board in an inclined position, and with a flat, soft, broad brush, lay on the first solution of nitrate of silver, beginning at the top and proceeding carefully and lightly downwards, taking all precaution that the entire surface of the paper be evenly and thoroughly covered. Now incline the board with its edge downwards that the superfluous moisture may run off, and so leave the paper to drain and dry. As soon as it is quite dry lay on the solution of iodide of potash in the same manner; when the paper is again about half dry, it must be taken off the board and dipped into or floated on water, taking care that no air bubbles intervene between the prepared side of the paper and the water. It may remain in the water for any period varying from five minutes to five hours; the only difference is that if it remains but the shorter period, it will be rather more sensitive, but will not keep so long uninjured. After this soaking, the paper should be fastened with a pin by one corner to some projecting wood or shelf, and suffered to drain dry, and then put away for use.

The whole of this process should be conducted in a *dark cool room. The flame of the candle or lamp must be covered with a yellow glass shade*, for if white light is used, or if the paper be dried by the fire, the operator will be mortified to find in the end a stained photograph, which he will be at a loss to account for. Neither in this or in any subsequent part of the proceeding should the paper be touched, either by *wiping, or with blotting-paper*, for such would disturb the surface and leave false markings which will afterwards appear.

Before placing in the camera it is more economical, as well as convenient, to use the solution of nitrate of silver in the first place only, and reserve the gallic acid for bringing out the impression. The gallic acid solution should, when used, be mixed with one-half gum water, which will prevent its sinking so deeply into the paper, and allow it to wash off freer. A saturated solution of sulphate of iron employed the same way will bring out the impression equally well with that of gallic acid, with this advantage that the picture fixes with rather more certainty.

Paper photographs possess the advantage of being cheaply procured and of giving any number of copies without the aid of the engraver; but are not equal in sharpness and beauty of delineation to the impressions received by the metallic of plates of Daguerreotype. Operators are well aware that the calotype suffers considerably after it is taken from the camera by the subsequent processes of washing, fixing, and transferring, and perhaps the inferiority will remain until some more suitable material can be found whereon to receive the negative picture. The surfaces of ivory, horn, skin, and Indian rubber, become with the same preparation equally sensitive with paper. Thin horn, such as is used by the lanthorn makers, is an admirable substance whereon to impress the negative picture, and very superior specimens have been procured upon it. The finest lines were not in the least disturbed by washing or rubbing, and from its semi-transparency it promised to yield equally good positive pictures; but there is a difficulty of obtaining it sufficiently free from veins and spots. Whenever horn is used, it must be placed in the camera between two pieces of plate-glass, otherwise it will warp in drying.

Positive Pictures.

Many attempts have been made to produce positive calotype pictures by a single process, but the methods proposed are all difficult of execution, and rarely successful.

Mr. Hunt has recommended the following process as giving very satisfactory results in copying engravings, leaves, etc., though it is hardly sensitive enough for the camera. We have somewhat abridged Mr. H.'s directions.

Good letter paper is soaked for five or ten minutes in a solution of forty grains muriate of ammonia, or muriate of baryta, in four ounces water. Each sheet is carefully removed from the fluid, placed on a glass or porcelain slab, wiped over with a very clean linen rag, and then hung up to dry. When dry, the paper, pinned by its four corners to a board, is washed with the following solution:—One hundred and twenty grains crystallised nitrate silver are dissolved in twelve fluid drachms distilled water and four fluid drachms alcohol added to it. This renders the solution opaque, but after a few hours it grows clear, and a minute quantity of a black precipitate falls, which must be separated by filtering

through white blotting-paper. This solution is applied with a very soft sponge-brush over one surface, care being taken that the fluid is equally diffused over every part of the paper, and that this is done without applying the brush a second time to any portion of the surface. The wet paper is now exposed, without delay, to bright sunshine,—the paper should only be prepared on bright days,—when the solar rays instantly darken the paper. The darkening often proceeds unequally at first, but a second application of the nitrate of silver, before the paper becomes hard and a renewed exposure to sunshine, will remedy this defect. The paper has now an uniform surface of a fine chocolate brown colour. It is now to be dried quickly in the dark, and preserved for use between blotting-paper.

The bleaching fluid is made as follows:—Thirty grains iodide of baryta are dissolved in an ounce of water; to this is added a single drop of sulphuric acid, by which some baryta is separated as a sulphate, and some free hydriodic acid is liberated and remains in the fluid. To use the paper in the camera, wash it over with this solution, and place the paper, carefully spread on a glass plate, wet in the camera. It is important that the wet paper should not be placed upon wood or any carbonaceous body, as in that case a peculiar blackening instead of bleaching will take place. Paper thus prepared is not very sensitive, and an exposure of from twenty minutes to half an hour will be required. The results, however are very beautiful. To copy engravings, the print must first be soaked in water, by which it is rendered transparent and protected from injury by the chemicals in the photographic paper. It is then laid out smoothly upon the glass of the copying-frame and the dark surface of the hydriodated paper pressed very closely against the face of the picture. Thus arranged it is exposed to good sunshine, and allowed to remain until the uncovered portion of the paper which rapidly bleaches begins again to turn brown. The paper being removed is placed in clean water, to dissolve the hydriodate, after which the picture is rendered permanent by fixing with hyposulphate soda. Botanical specimens, etc., are treated in a similar manner.

The following plan was introduced by Professor Grove, at the meeting of the British Association held at York. The above paper, or ordinary calotype paper, is darkened until it assume a deep brown colour, almost amounting to black; it is then re-dipped into the ordinary solution of iodide of potassium and dried. When required for

use, it is drawn over dilute nitric acid, one part acid to two-and-a-half parts water. In this state, those parts exposed to the light are rapidly bleached, while the parts not exposed remain unchanged. It is fixed in the usual method. Mr. Grove brought forward, on the same occasion, another process, by which a negative calotype was converted into a positive one. An ordinary calotype picture is to be taken in the camera and developed by gallic acid, then drawn over iodide of potassium, and dilute nitric acid, and exposed to full sunshine: while bleaching the dark parts, the light is re-darkening the newly precipitated iodide in the lighter portions, and thus the negative picture is converted into a positive one.

These processes are, as we have said, difficult to manage successfully; and the resulting pictures have, though more minutely defined, and free from many defects inherent to copies through paper, the same disadvantages as those of the Daguerreotype, viz. the positions are reversed, and the copies cannot be multiplied.

A good negative picture having been obtained and carefully set, copies may be procured on almost any kind of photographic paper. The following are the formulas for making the papers commonly used for the purpose. The Energiatype paper, which is also very suitable, is described further on. *

1. Mr. Fox Talbot's Photographic Paper.—Take a sheet of good paper, and having dipped it for a minute or so in a solution of common salt, one part of saturated solution to eight parts of water, dry it first in blotting paper, and then spontaneously. Wash one of the sides, previously marked, with a solution of nitrate of silver—eighty grains to one ounce of distilled water. Allow it to dry, and it is ready for use.

An improved Paper of this description may be made by using the following proportions:—25 grs. salt to 1 oz. of water, and 100 grs. nitrate silver to 1 oz. water. Wash the paper with the first solution by a sponge brush, and when dry lay on the silver solution with a large camel's hair pencil. The salt may be replaced by 20 grains muriate ammonia, or by from five to 25 grains muriate of baryta. The different substances and different strengths of the solutions will beautifully vary the tint of the picture produced.

* Photogenic Paper, of various kinds, may be obtained of Messrs. T. & R. Willats, 98, Cheapside.

Mr. Cundell's Paper.—To a solution of one drachm of nitrate silver, in twelve drachms of water, add strong ammonia, till the precipitate which falls is just re-dissolved. Wash the marked side of the paper over with this solution, then dip it in water containing forty grains common salt to the pint; apply the nitrate of silver solution as before, and dry carefully in the dark. It is better to leave a little oxide of silver in the ammoniacal solution rather than to add too much ammonia.

3. Mr. Cooper's Paper.—Soak the paper for a few minutes in a boiling solution of chlorate of potash, (the strength is immaterial;) dry it, and wash it on one side with a solution of nitrate of silver, sixty grains to the ounce of distilled water. This paper is not very sensitive, but the image can be fixed by washing only.

4. M. Daguerre's Paper.—Immerse the paper in hydrochloric (muriatic) ether, which has become acid from keeping; the paper is then carefully and completely dried. It is then dipped into a solution of nitrate of silver, and dried without artificial heat in a perfectly dark room. This paper is very sensitive when quite new, but gradually loses its impressionability.

5. Bromide Paper.—Dissolve 100 grains bromide potassium in one ounce distilled water, and soak the paper in this solution. Take off the superfluous moisture, and when nearly dry brush it over on one side only with a solution of 100 grains nitrate of silver to one ounce of water. This paper is readily prepared, and tolerably sensitive. If required to be very sensitive, it should be brushed over a second time with the nitrate of silver.

These papers really vary very little from each other, and we should recommend Nos. 1, 2, and 5. The same general rules must be observed in the preparation of each. They must all be dried in the dark after the nitrate of silver has been used. If the paper is brushed over, the brush must be large and broad, so that the whole of the sheet may be wetted in two or three sweeps, otherwise marks will appear in the paper corresponding to the lines made by the brush. If blotting paper is required, it must be frequently changed, and never used for two different preparations.

A sheet of either of the above papers may be taken and laid with the marked side upward, on a piece of board covered with flannel: on this paper must be laid the negative picture, with its face downwards, and over both a piece of plate glass, the glass and board being tightly presed together by screws or weights. The frame described, page 5, is a most convenient apparatus for this purpose. It must now be exposed to light, in about ten or fifteen minutes of bright sunshine, or in several hours of common daylight, a beautiful positive picture is produced, in which the lights and shadows are corrected. These pictures have a fine effect, though they lose somewhat of their sharpness in passing through the copy. They may be set with hyposulphate of soda, as directed for the *negative* pictures. If the negatives are clear, and the shadows dark, a great many copies may be obtained from them.

We may mention here, that copies of PRINTS, FEATHERS, LACE, etc., are obtained in the same manner as the positive pictures just described; and where it is necessary to reverse them afterwards, as in the case of prints, the process must be gone through twice; that is, a strong negative picture must be first obtained, and then positive copies must be got by printing from it. Beautifully accurate copies of a vast variety of objects may be procured in this way.

Some observations on this subject, which will be found under the head of ENERGIATYPE, will perhaps assist the operator.

Both negatives and positives are much improved by placing them under a sheet of highly glazed paper, and then polishing with a steel burnisher.

CATALYSOTYPE.

This process was introduced by Dr. Thomas Woods, of Ireland, and has been practised with some success. It is desirable to use unglazed copy paper for this process, or if highly glazed writing paper is used, it should be steeped in water to which hydrochloric acid has been added; two to three drops to three ounces water is sufficient, and this makes the paper imbibe the solutions equally. It is then brushed over with a solution consisting of syrup of ioduret of iron and distilled water each two drachms, tincture of iodine ten to twelve drops. When this has remained on the paper for a few minutes, so as to be imbibed, dry it

lightly with bibulous paper, and then, in a dark room, wash it over evenly by a camel's-hair pencil with a solution of nitrate silver, sixty grains in an ounce of distilled water. The colour should now be of a canary yellow; it is ready for the camera, and should be used as soon as possible. The time of exposure varies from two to thirty minutes. When the paper is removed from the camera no picture is visible, but when left in the dark a negative picture is gradually developed until it attains a great perfection. The bringing out may be hastened by the use of the Photographic Etna, described page 9. The picture is fixed by washing in water, then soaking for a few minutes in a solution of iodide potassium five grains to the ounce, and finally washing again in water.

"If," says Dr. Woods, "the acid solution," used to prepare glazed paper, "be too strong, it produces the very effect it was intended to overcome; that is, it produces yellow patches, and the picture itself is of a light brick colour on a yellow ground. When the tincture of iodine is in excess, partly the same results occur, shewing that the oxide of silver which is thrown down in both cases is re-dissolved by the excess of acid and iodine, and their quantities should be diminished. On the contrary, if the silver solution be too strong, the oxide is deposited in the dark, or by an exceedingly weak light, and in this case blackens the yellow parts of the picture, which destroys it. When this takes place, the silver solution should be weakened. If it be too weak, the paper remains yellow after exposure to light. If the ioduret of iron be used in too great a quantity, the picture is dotted over with black spots which afterwards change to white."

The following formula has been given for preparing the syrup of ioduret of iron:—Take of dry iodine 200 grains; fine iron wire, recently cleaned, 100 grains; white sugar in powder 4½ ounces; distilled water 6 ounces. Boil the iodine iron and water together in a glass mattrass, at first gently, to avoid the expulsion of iodine vapours; afterwards briskly, until about two fluid ounces of liquid remain. Filter this quickly, while hot, into a flask containing the sugar; dissolve the sugar with a gentle heat, and add, if necessary, distilled water to make up six fluid ounces.*

* Correspondent of "The Magazine of Science."

ENERGIATYPE.

The process which Mr. Hunt has designated the Energiatype, is one of the simplest and most convenient modes of obtaining photographic pictures; and the public are much indebted to this gentleman for the prompt and handsome manner in which he communicated his discovery through the pages of the 'Athenæum.'

"While pursuing," he says, "some investigations, with a view to determine the influence of the solar rays upon precipitation, I have been led to the discovery of a new photographic agent, which can be employed in the preparation of paper, with a facility which no other sensitive process possesses. Being desirous of affording all the information I possibly can to those who are anxious to avail themselves of the advantages offered by photography, I solicit a little space in your columns for the purpose of publishing the particulars of this new process. All the photographic processes with which we are at present acquainted, sufficiently sensitive for the fixation of the images of the camera obscura, require the most careful and precise manipulation; consequently, those who are not accustomed to the niceties of experimental pursuits, are frequently annoyed by failures. The following statements will at once shew the exceeding simplicity of the new discovery."

Here follows, in the original letter, the description of the process as then employed. We shall, however, introduce it to the amateur with such modifications as the experience of Mr. Hunt himself, and other gentlemen who have adopted the method, have suggested to us.

Preparations of the Paper.—Good letter paper, Whatman's, or Moinier's pure white is best, is first washed over with the following solution, viz. five grains succinic acid, dissolved in one fluid ounce water, to which is added about five grains common salt, and half a drachm mucilage gum arabic. When dry, the paper is drawn over the surface of a solution of sixty grains of nitrate silver in one ounce of distilled water. Allowed to dry in the dark the paper is now fit for use, is of a pure white, retains its colour, and may be preserved for a considerable time in a portfolio, until wanted for use.

The preparation of this paper is by no means difficult, but requires

much care and attention. The solutions must be applied very equally over the paper, which should be immediately hung upon a frame or clothes' horse to dry. Extreme care must be taken that the paper be not exposed to light, after the nitrate of silver solution has been applied, until required for use. Many of the disappointments experienced by the experimenters on the Energiatype are occasioned by a neglect of this precaution; as, although no apparent effect may have been produced by the exposure, the clearness of the subsequent picture will be seriously injured. The succinic acid must also be very pure. In the general way it will be found more convenient, and perhaps economical, to purchase the paper ready prepared. We shall now briefly describe the method of applying the Energiatype to the different purposes for which it is best adapted, premising that the varying circumstances of time, place, and light, will render necessary such modifications of the following directions as the experience of the operator may suggest. As a general rule, an open situation, sunshine, and, if possible, the morning sun, should be preferred, as the image is sharper, and the colour produced more intense and less affected by the subsequent fixing process.

NEGATIVE PICTURES.

In the Camera.—For a building, an exposure of half a minute in strong sunshine is usually sufficient; for a portrait, which can only be taken in the shade, two or three minutes is required. Directions for placing the camera, sitter, etc., etc., will be found under the Calotype process, at page 13.

Exact copies of prints, feathers, leaves, etc., may be taken, by exposing them to the light in the copying-frame, described p. 7, until the margin of the prepared paper, which should be left uncovered, begins to turn very slightly. If the object to be copied be thick, the paper must be allowed to assume a darker tint, or the light will not have penetrated it.

It has been found by experiment, that the sulphate of iron has the property of developing the latent images on papers prepared with other salts of silver, and that by using the acetate bromide, benzoate, etc., the most varied and beautiful effects are elicited.

The calotype picture may, it is said, be developed in this way after an exposure of one or two seconds only.

CHRYSOTYPE.

Sir John Herschel, whose various experiments have done so much for the art of Photography, is the discoverer of this process, and that of the Cyanotype, of which we shall next speak. They are both founded upon the use of the salts of iron as photographic agents. The Chrysotype process was communicated to the Royal Society in June, 1843, and is as follows:—

Paper is washed over with a moderately concentrated solution of ammonia-citrate of iron, and dried,—the strength of the solution being such as to dry into a good yellow colour, and not at all brown. In this state it is ready to receive a photographic image, which may be impressed on it, either from nature in the camera obscura, or from an engraving in a frame in sunshine. The image so impressed, however, is faint, and sometimes hardly perceptible. The moment it is removed from the camera, it must be washed over with a neutral solution of gold, of such strength as to have the colour of sherry wine. Instantly the picture appears; not, indeed, at once with its full intensity, but darkening rapidly up to a certain point. At this point nothing can surpass the sharpness and perfection of detail of the resulting photograph. The picture is now to be rinsed in spring water, which must be three times renewed. It is then blotted and dried, after which it is to be washed on both sides with a somewhat weak solution of hydriodate of potash. After being again rinsed and dried, it is now perfectly fixed. If the nitrate of silver be used instead of the solution of gold, the picture is brought out, but more slowly and with much less beauty.

CYANOTYPE OR FERROTYPE.

This name has been given, by Sir John Herschel, to several processes in which cyanogen is used in combination with iron. The term Ferrotype, which is sometimes applied to them, may with more propriety designate the whole of those photographic processes, a numerous class, in which iron may be employed as the developing agent.

First Process.—The paper is washed over, as in the Chrysotype, with a solution of ammonia citrate of iron. It is now exposed to light, and a latent picture impressed upon it. If the paper has sensibly

darkened, the picture will appear negative. It is now brushed over very sparingly and equally with a solution of the ferro-cyanate potash, in which is dissolved a little gum arabic. The negative picture quickly vanishes, and is more slowly replaced by a positive one of a violet blue colour, on a greenish yellow ground. If when dry the details are not sufficiently distinct, a second wash will generally bring out the picture, which should be beautiful and sharp.

Second Process.—A paper is prepared with a mixture of equal proportions of ammonia-citrate iron and ferro-sesquicyanate of potash. When a picture has been impressed, it is thrown into water and dried, and a negative picture results. If this picture is washed with a solution of the proto-nitrate mercury, it is readily discharged, but is susceptible of restoration by thoroughly washing out the mercurial salt, and drying the paper. A smooth iron, rather hot, but not sufficiently so to scorch the paper, is now passed over it, and the obliterated picture immediately re-appears, but of a brown tint. These photographs gradually fade and disappear, but may be again restored by the application of heat.

Third Process.—One part by weight of ammonia-citrate of iron is dissolved in eleven parts of water, and this is mixed with an equal quantity of saturated cold solution of bichloride mercury. Before a precipitate has had time to form, the solution is brushed over paper, which should have a yellowish rather than a blueish cast, and dried. This paper keeps well, and when used is exposed to light, until a faint but perfectly visible picture is impressed. It is then brushed over as rapidly as possible with a saturated solution of prussiate of potash, diluted with three times its bulk of gum water, so strong as just to flow freely without adhesion to the lip of the vessel. The wash must be spread with one application, evenly and very quickly, over every part of the paper. It is fixed by drying. Beautiful positive pictures are thus produced, which will bear immediate exposure tolerably well, but which after a few days will bear strong sunshine uninjured. If the impression be overdone, the darker shades will disappear: if too little, the whole runs into blot. The exact time of exposure can only be learnt by practice.

There are several other varieties of these processes, which are not

sufficiently important to be included here: the formula may be seen by reference to Sir John Herschel's Papers in the 'Philosophical Transactions.' The following process, communicated by him to the British Association in 1843, is, however, so curious, that we are induced to insert it here. If nitrate of silver, specific gravity 1.200, be added to ferro-tartaric acid, specific gravity 1.023, a precipitate falls, which is in a great measure re-dissolved by a gentle heat, leaving a black sediment, which, being cleared by subsidence, a liquid of a pale yellow colour is obtained, in which a further addition of the nitrate causes no turbidness; when the total quantity of the nitrated solution added, amounts to about half the bulk of the ferro-tartaric acid, it is enough.

The liquid so prepared does not alter by keeping in the dark. Spread on paper and exposed wet to sunshine (partly shaded) for a few seconds, no impression seems to have been made; but by degrees, although withdrawn from the light, it develops itself spontaneously, and at length becomes very intense. But if the paper be thoroughly dried in the dark, (in which state it is of a very pale greenish yellow colour,) it possesses the singular property of receiving a dormant or invisible picture; to produce which (if it be, for instance, an engraving that is to be copied) from thirty seconds to a minute's exposure in the sunshine is requisite. It should not be continued too long, as not only is the ultimate effect less striking, but a picture begins to be *visibly* produced, which darkens spontaneously after it is withdrawn. But if the exposure be discontinued before this effect comes on, an invisible impression is the result, to develope which all that is necessary is to breathe upon it, when it immediately appears, and very speedily acquires an extraordinary intensity and sharpness, as if by magic. Instead of the breath, it may be subjected to the regulated action of aqueous vapour, by laying it in a blotting-paper book, of which some of the outer leaves on both sides have been damped, or by holding it over warm water.

CHROMOTYPE.

M. Ponton was the first to point out the photographic properties of bichromate of potash. His process for preparing paper is as follows:—Immerse a well-sized paper in a saturated solution of bichromate potash, and dry by the fire. It is of a fine yellow colour, and keeps well in the

dark. When exposed to the rays of the sun, it becomes of a light brown; and if an engraving has been placed upon it, the resulting picture is negative. It is fixed by soaking in water. Mr. E. Becquerel improved upon this process by applying evenly over the paper a sizing of starch, and then steeping it in the bichromate solution as before. The picture having been taken, and the paper washed and dried, it is immersed in a weak alcoholic solution of iodine, in which it remains some time, and is then rinsed and carefully dried between blotting-paper, without much heat. When wet, the shades of the picture are of a fine blue; but when dry, of a deep violet. If the picture, while wet, is covered with a coating of gum, the colour is better preserved, and is more beautiful when dry.

Mr. Hunt announced the process, which is termed the Chromotype, at the meeting of the British Association in 1843. It is not sufficiently sensitive for the camera, but is valuable for copying engravings, etc. Good writing paper is washed over with sulphate of copper, in solution, about one drachm to an ounce of water; when dry, it is again washed with a strong, but not saturated, solution of the bichromate of potash, and again dried. The paper may be preserved in this state for a considerable time. When exposed to sunshine, it changes to a dull brown, and if checked here, a negative picture is produced; but if the action of light is continued, the browning gives way, and the picture becomes positive,—yellow on a white ground. From five to twenty minutes is usually required to produce the effect. In either case, if the picture be washed over with a solution of nitrate of silver, a very beautiful positive picture results. To fix the picture, wash it immediately in pure water, and dry it. If the water contains any muriates, the picture suffers, and long soaking entirely destroys it. When a few grains of common salt are added to the water, a curious effect is produced: the picture is apparently rapidly destroyed, but may be restored by an exposure to the sun of from ten minutes to a quarter of an hour, and is now of a lilac colour,—the shades depending on the quantity of salt used. No fresh process is required to fix it.

A beautiful variety of the Chromotype is thus described by Mr. Hunt. "A neutral solution of the chloride of gold is mixed with an equal quantity of the bichromate of potash. Paper is washed with this solution, and dried near the fire. On exposing this paper to light,

it speedily changes, first to a deep brown, and ultimately to a blueish black. If an engraving is superposed, we have a negative copy, blue or brown, upon a yellow ground. If this photograph is placed in clean water, and allowed to remain in it for some hours, very singular changes take place. The yellow salt is all dissolved out, and those parts of the paper left beautifully white. All the dark portions of the paper become more decided in their character, and accordingly as the solarization has been prolonged or otherwise, or the light has been more or less intense, we have either *crimson, blue, brown, or deep black photographs of a most beautiful character.*"*

AMPHITYPE.

This is another of the interesting and valuable discoveries of Sir John Herschel. It was given to the public at the last meeting of the British Association, and is described by him as follows :—

Paper, proper for producing an amphitype picture, may be prepared, either with the ferro-tartrate or the ferro-citrate of the protoxide or the peroxide of mercury, or of the protoxide of lead; by using creams of these salts, or by successive applications of the nitrates of the respective oxides, singly or in mixture, to the paper, alternating with solutions of the ammonia-tartrate or ammonia-citrate of iron,† the latter solutions being last applied, and in more or less excess. I purposely avoid stating proportions, as I have not yet been able to fix upon any which certainly succeed. Paper so prepared and dried takes a negative picture, in a time varying from half an hour to five or six hours, according to the intensity of the light; and the impression produced varies in apparent force from a faint and hardly perceptible picture, to one of the highest conceivable fulness and richness, both of tint and detail, the colour in this case being a superb velvety brown. This extreme richness of effect is not produced except lead be present, either in the ingredients used, or *in the paper itself.* It is not, as I originally supposed, due to the presence of free tartaric acid. The pictures in this state are not permanent.

* Researches on Light, by Robert Hunt, 1844.

† So commonly called, and sold as such; but as I am disposed to regard their composition, their chemical names would be ferro-tartrate and ferro-citrate of ammonia.

They fade in the dark, though with very different degrees of rapidity, some (especially if free tartaric or citric acid be present) in a few days, while others remain some weeks unimpaired, and require whole years for their total obliteration. But though entirely faded out in appearance, the picture is only rendered dormant, and may be restored, changing its character from negative to positive, and its colour from brown to black (in the shadows) by the following process:—A bath being prepared by pouring a small quantity of solution of pernitrate of mercury into a large quantity of water, and letting the sub-nitrated precipitate subside; the picture must be immersed in it, (carefully and repeatedly clearing off all air bubbles,) and allowed to remain till the picture (if anywhere visible) is entirely destroyed, or if faded, till it is judged sufficient from previous experience—a term which is often marked by the appearance of a feeble positive picture, of a bright yellow hue, on the pale yellow ground of the paper. A long time (several weeks) is often required for this, but heat accelerates the action, and it is often complete in a few hours. In this state the picture is to be very thoroughly rinsed and soaked in pure warm water, and then dried. It is then to be well ironed with a smooth iron, heated so as barely not to injure the paper; placing it, for better security against scorching, between smooth clean papers. If then the process has been successful, a perfectly black positive picture is at once developed. At first it most commonly happens that the whole picture is sooty or dingy to such a degree that it is condemned as spoiled; but on keeping it between the leaves of a book, especially in a moist atmosphere, by extremely slow degrees this dinginess disappears, and the picture disengages itself with continually increasing sharpness and clearness, and acquires the exact effect of a copper-plate engraving on a paper more or less tinted with pale yellow. I ought to observe that the best and most uniform specimens which I have procured, have been on paper previously washed with certain preparations of uric acid, which is a very remarkable and powerful photographic element. The intensity of the original negative picture is no criterion of what may be expected in the positive. It is from the production, by one and the same action of the light, of either a positive or a negative picture, according to the subsequent manipulations, that I have designated the process thus generally sketched out, by the term *amphitype*,—a name suggested by Mr. Talbot, to whom I communicated this singular result; and to this process, or class

of processes, (which I cannot doubt when pursued will lead to some very beautiful results,) I propose to restrict the name in question, though it applies even more appropriately to the following exceedingly curious and remarkable one in which silver is concerned. At the last meeting I announced a mode of producing, by means of a solution of silver, in conjunction with ferro-tartaric acid, a dormant picture brought out into a forcible negative impression by the breath or moist air. The solution then described, and which had, at that time, been prepared some weeks, I may here incidentally remark, has retained its limpidity and photographic properties quite unimpaired during the whole year since elapsed, and is now as sensitive as ever,—a property of no small value. Now, when a picture (for example, an impression from an engraving) is taken on paper washed with this solution, it shows no sign of a pieture on its back, whether that on its face be developed or not; but if, while the actinic influence is still fresh upon the face, (*i. e.* as soon as it is removed from the light,) *the back* be exposed for a very few seconds to the sunshine and then removed to a gloomy place, a *positive picture, the exact complement of the negative one on the other side*, though wanting of course in sharpness if the paper be thick, *slowly and gradually makes its appearance* there, and in half an hour or an hour acquires a considerable intensity. I ought to mention that the "Ferro-tartaric" acid in question is prepared by precipitating the ferro-tartrate of ammonia (ammonia-tartrate of iron) by acetate of lead, and decomposing the precipitate by dilute sulphuric acid.

P. S. When lead is used in the preparation of Amphitype paper, the parts on which the light has acted are found to be in a very high degree *rendered waterproof*.

ANTHOTYPE.

The influence of light upon the growth and germination of plants is very curious and interesting. The facts connected with this subject have been investigated by Mr: Chevrieul, Mr. Hunt, and Sir John Herschel. To the latter gentleman we are indebted for the inquiries which have led to the publication of the Anthotype process. He found that the expressed juices, and alcoholic or watery infusions of certain

flowers, more particularly the papaver rhœas, the coschoous japonica, the violet, rose, ten weeks' stock, etc., etc., when spread on paper, were very sensitive to light. To procure this colouring matter, the petals of fresh and well-selected flowers are bruised to a pulp in a marble mortar, either alone or with the addition of a small quantity of alcohol,—the juice is expressed by squeezing the pulp through a piece of fine linen. The paper is prepared in the following manner:—"The paper should be moistened on the back by sponging and blotting off. It should then be pinned on a board, the moist side downwards, so that two of its edges (suppose the right hand and lower one) shall project a little beyond those of the board. The board being then inclined twenty or thirty degrees to the horizon, the alcoholic tincture (mixed with a very little water, if the petals themselves be not very juicy) is to be applied with a brush, in strokes from left to right, taking care *not to go* over the edges which rest on the board, but to pass clearly over those that project; and observing also to carry the tint from below upwards by quick sweeping strokes, leaving no dry spaces between them, but keeping up a continuity of wet spaces. When all is wet, cross them by another set of strokes from above downwards, so managing the brush as to leave no floating liquid on the paper. It must then be dried as quickly as possible over a stove, or in a current of warm air, avoiding, however, such heat as may injure the tint." If alcohol has not been added, the extract must be applied to the paper immediately. Most of the papers so prepared require an exposure of many days, from twenty to thirty, to produce a decided effect, and the pictures obtained are not always permanent. This will of course preclude their being of practical utility; but the changes produced are so remarkable, that we could not, with propriety, omit mentioning them. A full account of Sir John Herschel's experiments will be found in his Memoir, or "The Action of the Rays of the Solar Spectrum on Vegetable Colours," etc., published in the second part of the Philosophical Transactions for 1842.

Similar effects are produced by light in the gums, resins, and residua of essential oils, when thin films are spread upon paper or on metal plates. A paper prepared with an alcoholic solution of guaiacum, and placed in an aqueous solution of chlorine, acquires a beautiful blue colour; it is very sensitive, and may be used for copying engravings, the resulting picture penetrating the paper, and appearing on the back with almost the same intensity as on the face. The images, however, speedily fade.

COLORING PAPER PHOTOGRAPHS.

A very good effect may be produced by tinting the sun pictures, but the artist must select his colors with judgment, so that the pigment employed shall not, while in a moistened state, act upon the salts in the paper, or be acted upon by them. By the use of the colored French chalks, the appearance of a photograph is much improved; or by stippling on dry colours in the same manner as directed for Daguerreotype pictures in No. 2 Manual.

THERMOGRAPHY.

If a coin be laid on a polished silver plate, and the plate be then gently heated and allowed to cool, an impression will be formed of the coin on its surface, which will become visible on breathing over the plate. The figure will remain for several days, only requiring to be breathed on to become visible, and if the plate be exposed to the vapour of mercury, the impression becomes fixed.

Almost any substance laid upon a polished surface of glass, slightly warmed, will produce an impression when breathed on; the definition of which varies with the substance employed. For instance, a coin allowed to remain on a looking-glass a few minutes, and breathed over three or four times, will, on the coin being removed, be rendered visible for weeks by merely breathing on the surface of the glass, provided it be not rubbed during that time, which would destroy the impression. The same result is produced by exposure to the sun-light for several hours.

THE FLUOROTYPE.

This process, which is characterised by its easy preparation, and the sensibility of the papers when carefully prepared, consists in the formation of a salt of silver, which must be considered as a fluo-bromide of silver. It is difficult to say, which is the best manner of proceeding; but the difference, as it regards the sensibility of papers is so very trifling, that it is not of much importance. The paper is to be washed first with the bromide of potassium, and then

with the fluate of soda; or, which will be found perhaps the best plan, the two salts may be united. The strength of the solutions should be as follows:—

{ Bromide of potassium.... 20 grains.
{ Distilled water ..... 1 fluid ounce.

{ Fluate of soda ..... 5 grains.
{ Distilled water..... 1 fluid ounce.

Mix a small quantity of these solutions when the papers are to be prepared, and wash the paper once over with the mixture, and when dry apply nitrate of silver, in solution, 60 grains to an ounce of water. These papers keep for some weeks without injury, and they become impressed with images in half a minute in the camera. This impression is not sufficiently strong to serve, in the state in which it is taken from the camera, for producing positive pictures, but it may be rendered so by a secondary process.

The photograph is first soaked in water for a few minutes; it is then placed upon a slab of porcelain or glass, and a weak solution of the protosulphate of iron applied, which very quickly darkens, all the parts on which the light has acted, to a dark brown, and every object is brought out with great clearness. When the best effect is produced the process must be stopped. All that is necessary is to soak the paper in water, and then fix the drawing with hyposulphate of soda.

In the preceding pages we have endeavoured to include all the Photographic processes which will be really useful to amateurs. There are many varieties of all these; every successful practitioner having his favourite formula, or modus operandi. To record all those that have been announced to the world during the last two or three years would require a volume, and would confuse rather than direct. We would recommend our readers to acquire a practical acquaintance with such as have been described; and then if they have some chemical knowledge, a small portion of time devoted to the consideration of the general principles upon which they are all conducted, will possibly enable them to introduce divers modifications and improvements. We have already pointed the way to such inquiries in referring to Sir John Herschel's papers in the Philosophical Transactions, and to Mr. Robert Hunt's Researches on Light, which, with a few papers scattered through some of our scientific periodicals, comprise everything of importance that has been written on the subject.